[aps,pra,amsmath,amssymb,amsfonts,showpacs]revtex4 graphicx document Nonlinear interaction of two photons at a one-dimensional atom: spatiotemporal quantum coherence in the emitted field Kunihiro Kojima[1] kuni@es.hokudai.ac.jp Holger F. Hofmann[1,2] Shigeki Takeuchi[1,2] Keiji Sasaki[1] [1]Research Institute for Electronic Science, Hokkaido University, Kita-12 Nishi-6, Kita-ku, Sapporo 060-0812, Japan

abstract The nonlinear photon-photon interaction mediated by a single two-level atom is studied theoretically based on a one-dimensional model of the field-atom interaction. This model allows us to determine the effects of an atomic nonlinearity on the spatiotemporal coherence of a two photon state. Specifically, the complete two photon output wave function can be obtained for any two photon input wave function. It is shown that the quantum interference between the components of the output state associated with different interaction processes causes bunching and anti-bunching in the two photon statistics. This theory may be useful for various applications in photon manipulation, e.g. quantum information processing using photonic qubits, quantum nondemolition measurements, and the generation of entangled photons.